Engineered Components | SHUTTERS

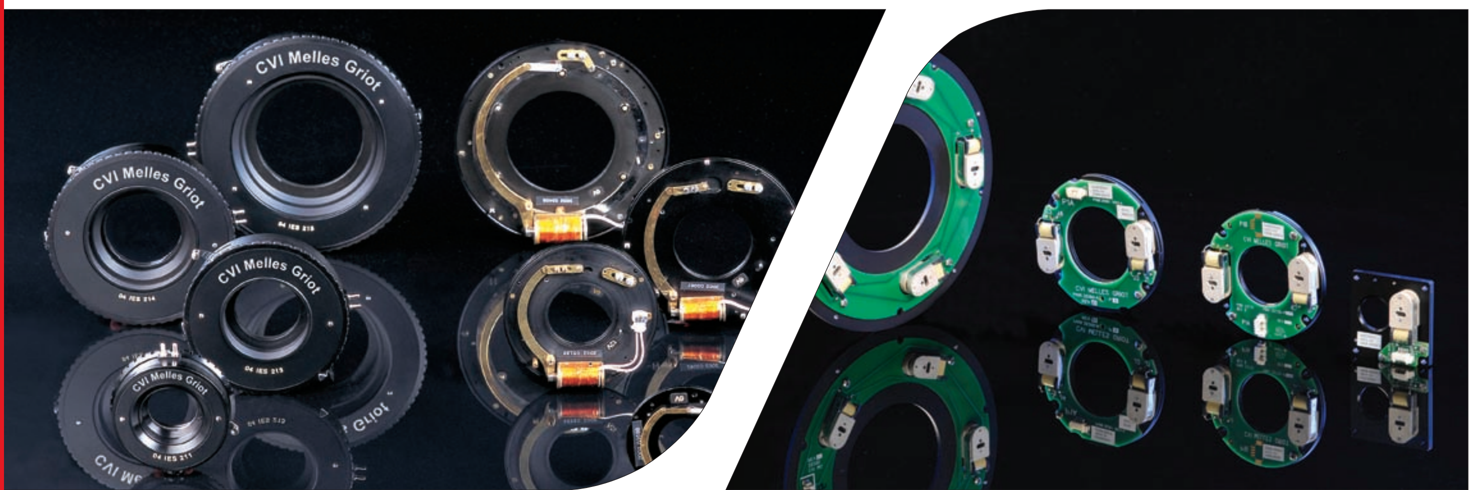
Shutter Capabilities

We manufacture a wide range of standard and custom electro-mechanical shutters for laboratory/research, biotechnology, instrumentation, military, homeland security, and aerospace applications. We specialize in application-specific packages/designs to fit available space in existing and new camera, sensor and thermal imager applications. CVI Melles Griot shutters are rugged, low noise, low power consumption products adaptable to a wide range of scientific and industrial applications. CVI Melles Griot is a global supplier and is compliant with EAR and ITAR.

Our production facility is equipped with specialized tooling and automated assembly and test systems organized to achieve product uniformity, quality, and low cost. Our experienced applications engineering personnel are available to address custom applications and to optimize standard or custom shutters for your use.

Shutter Performance Specification	Typical Performance*	Customization
Aperture Diameter	From 14.7 to 63.5 mm	up to 225 mm
Speed (Exposure Time)	From 1/60 sec to infinity	down to 3 msec
Number of blades	From 1 to 6	As required
Blade coating IR emissivity (for up to 14 micron spectral range)	>85%	>90%
Temperature	-40°C to +70°C	-60°C to +100°C
Shock Resistance (blade position retention)	Secure after repeated 40 g shock, any orientation	150 g
Power consumption	As low as 1.3 W	0.5 W
Weight	As low as 17 g	8 g
Vibration Resistance	0.08 g^2/Hz, all axes	0.15 g^2/Hz, all axes
Life	2 million cycles	10 million cycles

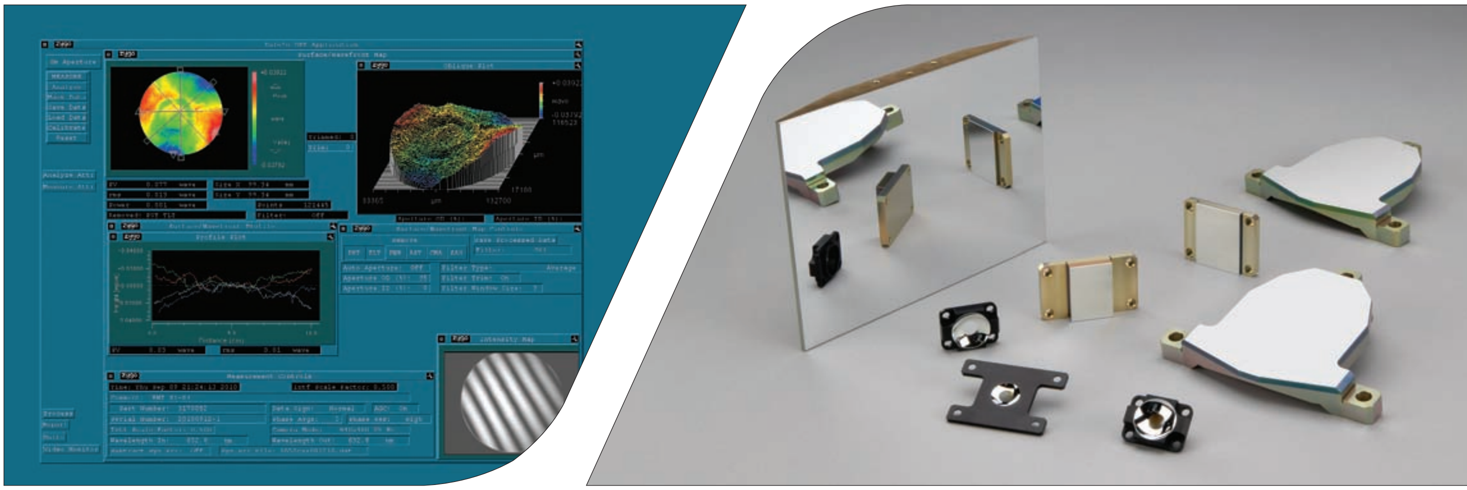
* Based on actually achieved performance for standard products



DIAMOND TURNING & MOLDED OPTICS | # Engineered Components

	Diamond Turned		Molded	
Surface Tolerances	Typical	Mfg Limit	Typical	Mfg Limit
Polished surface quality (scratch-dig)	40-20	10-5	40-20	20-10
Diamond Turned surface roughness (Å, RMS)	20 - 100	5	30	5
Surface power (waves, P-V @ 633 nm)	λ/4	λ/20	λ	λ/20
Surface irregularity (waves, P-V @ 633 nm)	λ/4	λ/20	λ/4	λ/20
Dimensional Tolerances				
Diameter (mm)	±0.1	±0.013	±0.02	+0.00/-0.00
Center thickness (mm)	±0.1	±0.01	±0.02	±0.00
Wedge (arc seconds)	30	1	15	1
Clear aperture (%)	90	98	90	99

- For Diamond Turned optics, diameter up to 250 mm
- For Molded optics, diameter range from 0.3 to 55 mm
- For Materials see pgs 6-7



The general tolerance specifications above provide a guideline regarding manufacturing capabilities for uncoated optics ranging in size up to 250 mm. The manufacturing limits are not absolute and may vary depending on material; tighter tolerances may be possible. Part specific tolerances may vary. All specifications do not need to be from single column.

Engineered Components | MRF®

Magneto-Rheological Finishing

Magneto Rheological Finishing (MRF®) is an advanced technology that works as a post processing step for optics that have been conventionally or CNC polished to create optical surfaces with irregularities better than $\lambda/60$.

This technology is based on using a polishing slurry that contains magnetic particles such that the viscosity of the fluid dramatically increases in the presence of a magnetic field. MRF® polishing uses this principle to create a uniform "polishing pad" by flowing polishing fluid through a magnetic field near an optical surface. This resulting sub-aperture polishing pad is continuously renewed as fresh polishing compound is pumped into the magnetic zone thus creating a steady state and predictable polishing process.

The MRF® polishing sequence is based on taking an optical surface that has already been polished to cosmetic and radius specifications. The optical surface is then characterized by high accuracy interferometry (e.g., a sub-aperture stitching interferometer*) to determine its initial surface profile (irregularity). The surface profile is electronically sent to the MRF® polishing system where a unique tool path is calculated. The MRF® polishing system uses this tool path for final figuring of the surface to improve its irregularity to world-class levels of precision.

CVI Melles Griot's MRF® system can polish spherical, flat, cylindrical, and aspheric surfaces. Typical uses include fabricating $\lambda/20$ to $\lambda/40$ spherical elements for high precision imaging lenses, correcting transmitted wavefront through cube beam splitters and prisms, and generating very high precision mirrors. MRF® technology can also be used to figure thin optics and tune waveplate performance.

CVI Melles Griot has extensive experience in integrating MRF® technology into optical fabrication. Our process minimizes the generation of mid-spatial frequency errors, which some users have found a drawback to this technology. This has allowed us to produce high quality surfaces such as those required for our Absolute™ product line of $\lambda/40$ interferometer transmission spheres and $\lambda/50$ transmission flats.

- Precision polishing of optical surfaces to $\lambda/60$
- Transmitted wavefront correction of windows and prisms
- Surface correction of high accuracy mirrors
- Fine figuring of thin optical elements
- Polishing of aspheric surfaces

* see Metrology and Design on page 8

OPTICAL CONTACTING | Engineered Components

Advantages In Optical Performance

- No glue or adhesive material is needed so there is no variance in the physical properties of the bound object and adhesive
- Heat sensitive polymers are not used and the part is limited by the material properties of the bulk solid only
- Higher laser damage threshold
- Negligible scattering
- Higher transmission
- Minimal beam displacement

Advantages For Optical Fabrication

- Maintaining parallelism in the Arc-second regime

Products

- Waveplates
  - True optical measurement of retardation tolerance
  - Minimizes the absorption contribution from an equivalent product that uses cement
  - Important in high power laser applications
- Cubes
  - Minimizes absorption in high power laser applications
  - Minimizes beam deviation contribution from a cemented interface
- Etalon spacers
  - Minimizes the wedge contribution in the finesse calculation